Sampling and analysis plan for

Arrastra Creek Characterization

San Juan County, Colorado

June, 2002

Prepared for the Animas River Stakeholders group by Kay Zillich

Approved by _______________________________________ date ___________
San Juan RC& D

Approved by _______________________________________ date __________
Animas River Stakeholders Group

Approved by ____ date _________

Table of contents

Project/Task Organization

The Animas River Stakeholders Group (ASRG) in cooperation with U. S. Geological Survey (USGS), Bureau of Land Management (BLM) and other participating stakeholders will coordinate the Arrastra Gulch Characterization Project under a grant provided by the Colorado Water Quality Control Division (WQCD) to the San Juan RC&D. Bill Simon is the Watershed Coordinator for the ASRG. Macroinvertebrate and water quality sampling will be done by trained personnel from member organizations of the ARSG. Samples will be analyzed by an EPA certified Lab. Results will be entered into the publicly-available database maintained by the ASRG, and into EPA's STORET database at the discretion and task of the WQCD.

Problem Definition/Background

The discovery of gold in Arrastra Gulch brought miners to the Silverton area in the early 1870's. The discovery of silver in the base-metal ores was the major factor in establishing Silverton as a permanent settlement. Between 1870 and 1890, the richer ore deposits were discovered and mined to the extent possible. Not until 1890 was any serious attempt made to mine and concentrate the larger low-grade ore bodies in the area. By 1900, there were 12 concentration mills in the valley sending products to the Kendrick and Gelder Smelter near the mouth of Cement Creek. Mining and milling slowed down circa 1905, and mines were consolidated into fewer and larger operations with the facilities for milling large volumes of ore. After 1907 mining and milling continued throughout the basin whenever prices were relatively favorable. By the 1970's only one year round producing mine (Sunnyside Mine) remained in the county. This mine ceased production in 1991, and has since undergone extensive reclamation efforts.

The Animas River and many of its tributaries above Silverton carry high concentrations of metals from both mining and natural sources. The ASRG and its member entities have undertaken extensive sampling to characterize the water quality of the upper Animas Basin, and prioritize locations where treatment could result in better water quality.

During the 2001 Rule Making Hearing for stream standards on the Animas River it was recognized that Arrastra Creek (segment 3c) and Animas River from Eureka to Silverton (segment 3a) needed further characterization to determine what factors were limiting aquatic life. This project focuses on the Arrastra Creek portion, and is described below.

Project/Task Description

This project will be focused on Arrastra Creek (segment 3c) and its impacts on the Animas River (segment 3a) as measured immediately above and below the Arrastra Creek confluence and at station A68. Only five water quality samples have been taken so far at the mouth of Arrastra Creek, and fewer samples taken upstream. Little can be determined from so few samples, but Zinc, Cadmium and Copper are believed to exceed Table Value Standards. It is suspected that dissolved metals are entering through groundwater sources. Historic data indicate that trout do not exist in Arrastra Creek. Evaluation of data from draining adits and mine wastes in Arrastra basin identified by the NPS Lower Animas Characterization Project did not clearly identify the limiting factor(s) or the source(s). Therefore, it is necessary to gather further information.

First, a rapid reconnaissance of the existing biological communities and condition will be accomplished to determine the extent and location of aquatic life in the stream. Earlier investigations concluded that trout are not present. This reconnaissance will evaluate benthic macroinvertebrate populations, hoping to differentiate areas where aquatic life exists from those areas that either do not support macroinvertebrates or the insects appear to be limited. Aquatic community sampling should help define where water quality is better and where it is worse. Water quality samples will be collected as a screening reconnaissance when bug collection occurs, using the River Watch QAPP protocols (Rivers of Colorado Water Watch Network Sample Plan September 2002, RW QAPP December 2000)

Following a review of the reconnaissance effort, a more vigorous water quality sampling of the areas, hopefully focused to some extent by the biological sampling, will ensue. Sampling will be focused in the period during which standards are exceeded. Some sampling will occur at other times of the year, also. In addition, Arrastra Gulch will be electrofished to verify presence or absence of trout.

TASK 1, BIOLOGICAL RECONNAISSANCE

Representative semi-quantitative samples of benthic macroinvertebrates will be collected at periodic intervals on Arrastra creek. We will be using either a surber or a modified kick net, depending upon stream flow conditions, to do 3 kicks/station of one square meter area, non-composited. The River Watch QAPP will be followed for collection, laboratory, i.d., etc. This will produce comparable data to the data collected during the previous ARSG Biomonitoring Program (Animas River Biological Macroinvertebrate Investigation and Monitoring Project (QAPP). An evaluation of microhabitat will be completed for each area kicked (River Watch protocol, easy form). A general instream and riparian habitat analyses will also be conducted. Subsequent water quality sampling may be focused on areas where the macroinvertebrates indicate probable changes in water quality.

TASK 2, GEOCHEMICAL CHARACTERIZATION

Water quality samples will be collected for further evaluation and bracketing. These samples will follow River Watch protocol. Post reconnaissance, subsequent water quality and flow sampling will be focused on areas where the macroinvertebrates indicate changes in water quality as well as above and below Arrastra on the Animas River and at A68 gauge. Samples will be sent to an EPA certified laboratory for analysis. Sampling protocol is included in the appendix.

TASK 3, ANALYSIS OF ARRASTRA CREEK

Resulting water quality data will be analyzed to determine sources of metal loading, feasibility of Arrastra Creek to contain aquatic life, and recommendations for adoption of applicable standards.

TASK 4, ANALYSIS OF CONTRIBURIONS TO THE ANIMAS RIVER

The same water quality data set will also be used to calculate the load contribution of Arrastra Creek to segment 3a of the Animas River.

TASK 5, CHARACTERIZATION OF SILVER LAKE

The same water quality sampling described above for Arrastra Creek will be used for inlets and the outlet to Silver Lake, at the head of Arrastra Creek. We know little about the Lake, therefore water quality and aquatic life samples will be for strictly qualitative purposes in this project. We hope to hand carry a raft to this remote site so we can determine the proper number of transects to conduct and depth profiles to be representative. The depth profiles will be determined using meters that measure water quality parameters including dissolved oxygen, pH, and conductivity. It will also be determined on site how many water quality samples will be collected at what depths and transect stations.

Data Quality Objectives for Measurement Data

The objective of this study is to determine sources and magnitude of loading of metals in Arrastra Creek.

BENTHIC MACROINVERTEBRATES

The use of macroinvertebrates as a reconnaissance tool to focus subsequent water quality testing has not been done in the Basin before. We are not trying to produce results comparable to other studies. However, the sampling and analysis protocol in this study will remain similar to protocols of previous studies in the Upper Animas watershed so that sample site characteristics can be compared to the characteristics of other Animas watershed sites. (see ARSG Biomonitoring QAPP).

Accuracy of macroinvertebrate samples is of lesser importance than precision, since samples will be primarily used to compare to each other to detect change from one location to another. The segment we will sample is similar gradient and elevation throughout the reach. Therefore, it is hypothesized that gradient and or elevation will not be the primary factor in macroinvertebrate community changes. If an analyses of habitat is conducted that assists in assessing the limitations posed by habitat; then water quality will remain as the probable limiting factor. Precision will be enhanced by adherence to the protocols, and by doing all macroinvertebrate sampling on Arrastra Creek during a short duration. Precision will be checked by not compositing samples, thereby allowing comparison of sub-samples.

Representativeness of the macroinvertebrate samples will be high because Arrastra Creek is a small stream and the two samples of one square meter each will cover a large portion of the stream width. Sampling protocol may be adjusting to meet the needs of current field conditions, while maintaining protocols developed by River Watch (the Rivers of Colorado Water Watch Network QAPP). Since the macroinvertebrates will be used as a reconnaissance tool, there is no fraction of the planned data that must be collected in order to fulfill a statistical criterion.

WATER QUALITY

For water quality samples the use of the same techniques (as defined in the appendix) at each location on Arrastra Creek will insure that all the Arrastra Creek data is comparable. Since part of the project is to assess loading from Arrastra to the Animas River, the use of these protocols (which are similar or identical to protocols used in the past throughout the Animas basin) will help insure that the new Arrastra data will be comparable to the existing data on the Animas River.

Precision and accuracy for dissolved metals are controlled by the field sampling technique and laboratory procedures. Precision will be evaluated by the duplicate samples sent to the laboratory. Accuracy will be evaluated by the blank samples sent to the laboratory. Selection of a certified lab will help insure precision and accuracy.

Water quality sampling will be concentrated, but not limited to, the time of year that Arrastra Creek exceeds water quality standards..

The higher the frequency of sampling the better the data set is for characterizing a stream. The sampling described here will be adequate to characterize Arrastra to the same detail as other tributaries to the Animas River. There is no fraction of the planned data that must be collected in order to fulfill a statistical criterion.

Sampling Process Design/ Sampling Methods Requirements

Benthic macroinvertebrate samples may be collected from riffles above and below springs and tributaries, and above and below known geologic features as well as on a regularly spaced lineal grid. The purpose of this sampling is to assist with the location of significant changes in water quality from surface or ground water sources to the creek. It is not meant to define or characterize the condition of any biological parameter but it will also be used to identify a baseline condition for the stream.

Water quality samples and flow measurements will be taken at several locations such that significant in-flow metal contributions can be bracketed. Water quality samples and stream flow data will be used to characterize the concentrations, loads, and seasonal distribution of metal concentration exceedances throughout the stream segment, as well as the loading contributions to Segment 3a. .

FISH AND BENTHIC MACROINVERTEBRATES

Three locations (above the mouth of Arrastra, midway up Arrastra, and near the Grey Eagle mine) will be electro-fished to ascertain the presence or absence of fish. Benthic macroinvertebrates will be sampled near the same locations. Macroinvertebrate samples will also be taken in the stream below the outlet of Silver Lake and above the inlet, if favorable conditions exist. Electro-fishing will not be necessary at these locations because of the very low stream flow.

Sampling locations will be flagged prior to initiation of sampling, to insure that sufficient sampling supplies are on hand to complete the sampling in a short duration.

Sample collection and processing will be in accordance with the procedures described in Rapid Bioassessment Protocols For Use in Streams and Rivers – Rapid Bioassessment Protocol III – Benthic macroinvertebrates and the River Watch QAPP, with the following changes:

1. Flow conditions in Arrastra creek will largely dictate which net to use. A modified rectangular dip net will be used as in the previous Animas aquatic life surveys by the ARSG Biomonitoring Program or a Surber net, which was also used in the Animas aquatic life survey. Using River Watch protocols, either net will produce comparable data.

2. Random number and spacing will not be used to determine sample location within the riffle. Due to high stream gradient and small stream size sampling will be attempted in similar velocities within riffles only.

3. A semi-quantitative method will be used. All organisms will be counted for each sample (not composites), 2-3 samples from each site. Samples will be sent to a laboratory for

counts and identification to families. This will provide baseline benthic macroinvertebrate information comparable to that collected for the Animas River and tributary mouths throughout the watershed. (see River Watch QAPP).

WATER QUALITY

Sampling will progress from downstream to upstream locations to eliminate sediment disturbance in subsequent samples. Surface water samples will be collected by immersing the sample bottle several inches beneath the water surface with the mouth of the sample bottle facing upstream. A separate surface sample may be collected if immiscible fluids are observed. To collect such a sample, the sample container will be inverted, lowered to the approximate sample depth and held at about a 45-degree angle with the mouth of the bottle facing downstream.

If surface water samples cannot be collected directly into the sample container, a decontaminated 1liter bottle will be used to collect the sample. The bottle will be rinsed three times in the water to be sampled prior to collecting the sample. Care will be taken to avoid excessive agitation when transferring samples to the sample containers.

Water samples for dissolved metals analysis will be field filtered with a 0.45 micron filter into the sample container and then preserved at a pH of 2 with nitric acid. Water samples for total metals analysis will not be filtered, but will be preserved at a pH of 2 with nitric acid. A non-filtered, non-acidified sample may be collected for anions.

Filtration will be done in accordance with "Standard operating procedures for the filtration of water samples" from the Quality Assurance Project Plan for the Colorado Nonpoint Source Monitoring Program (attachment 4); or with the following modification: Disposable encapsulated .45 micron filters (Gelman Sciences ion chromatography arcodisc) may be used in place of the filter in the Swinnex filter holder. In this case, filters are rinsed with approximately 10 ml of the water to be sampled before the sample is collected. If the filter clogs, a new disposable encapsulated filter will be used. The new filter will also be rinsed with approximately 10 ml of the water to be sampled before continuing with the sample collection.

In-field measurements of pH, conductivity, temperature, and flow will be made for all water samples. Manufacturers instructions for calibration and measurement of pH and conductivity will be followed. Type of meter will be noted on the field sheet. Flow will be taken using BASKI 1", 2" or 4" flumes, or appropriate current meters. Flow measurement will be in accordance with the "Standard operating procedures for the collection of flow, pH, temperature and conductivity measurements" from the Quality Assurance Project Plan for the Colorado Nonpoint Source Monitoring Program (attachment 5).

Measures will be taken to minimize the amount of in-field equipment decontamination required for the sampling event. Reused sampling equipment will be decontaminated

prior to the sample event. Decontamination will be achieved by washing with a non-phosphate detergent and triple rinsing with de-ionized water. Field equipment will be decontaminated by triple rinsing in the field.

Sample Handling and Custody Requirements

Sample containers will be labeled with permanent marker or wax pencil directly on plastic bottles and on label tape on glass containers. The label shall contain the following sample identification information:

<u>Waterbody</u> - name and station number.
<u>Date</u>
<u>Samplers initials</u>
<u>Remarks</u> - special processing such as filtration, split sample, etc.
<u>Time</u> - if multiple collections are made from same site.
<u>Sample preservation</u> – (HNO_3)
Filtered and unfiltered samples from a single site, along with a copy of the field data form, will be kept together in a plastic bag. Immediately after collection, samples will be kept in a cooler with ice at all times until they are transferred to the laboratory refrigerator, or analyzed. Samples must not be allowed to freeze. The necessary sample field documentation will be filled out on site (date, time, sampler, notes) on the Animas River Field data form (attachment 1). Water Quality Data - Stream Sample sheet (attachment 2) will be completed for those samples to be submitted to the CDH Laboratory.

Sample custody consists of two components: documentation and actual physical custody of the official sample. Physical custody consists of two phases: custody in the field and custody in the laboratory. Sample custody is less stringent for characterization and Best Management Practices monitoring than it would be for samples collected for enforcement or standards setting.

The following principles apply to all handling of samples from the point of collection through the placing of a sample in a secured location at the laboratory. The sample is considered in "custody" if:

1. It is in one's actual physical possession or view.

2. It is in ones physical possession so as not to be tampered with, i.e. under lock and restricted key or under official seal.

3. It is retained in a secured area with restricted access.

4. It is placed in a container and secured with an official seal(s) evidence tape such that the sample cannot be reached without breaking the seal(s).

Chain-of-custody form supplied by the lab, [and containing the same elements as the chain of custody form in “Standard operating procedures for field samplers” from the Quality Assurance Project Plan for the Colorado Nonpoint Source Monitoring Program (attachment 3)] will accompany the cooler from the sampling site to the lab.

Analytical Methods Requirements

Analytical methods to be followed in this study are listed below. The methods used are described in EPA Region VIII’s standard operating procedures. Any problems with the analytical methods that may be encountered during the study will be addressed by the laboratory technical manager.

Group	Constituent	Units of measurement	Reporting Limit	Preservative	Field Filtration	Holding time	EPA analysis Method number	Container type
Field parameters								
	Temperature							
	Specific conductance	mS/cm	1	--	None	Field analysis	1201	In situ or field container
	pH	--	0.01	--	None	Filed analysis	150.1	In situ or field container
Anions	Sulfate	mg/l	1.0	None	None	28 days	300	500 mL polyethylene
Trace metals	Aluminum	μg/l	40.	2ml HNO_3/liter	0.45 μm	6 months	200.7	1 liter polyethylene bottle, acid rinsed
	Arsenic	μg/l	1.	2ml HNO_3/liter	0.45 μm or none	6 months	200.9	1 liter polyethylene bottle, acid rinsed
	Iron	μg/l	5.	2ml HNO_3/liter	0.45 μm	6 months	200.7	1 liter polyethylene bottle, acid rinsed
	Cadmium	μg/l	0.5	2ml HNO_3/liter	0.45 μm	6 months	200.9	1 liter polyethylene bottle, acid rinsed
	Copper	μg/l	0.8	2ml HNO_3/liter	0.45 μm	6 months	200.9	1 liter polyethylene bottle, acid rinsed
	Lead	μg/l	0.8	2ml HNO_3/liter	0.45 μm	6 months	200.9	1 liter polyethylene bottle, acid rinsed
	Manganese	μg/l	1.	2ml HNO_3/liter	0.45 μm	6 months	200.7	1 liter polyethylene bottle, acid rinsed
	Nickel	μg/l	5.	2ml HNO_3/liter	0.45 μm or none	6 months	200.7	1 liter polyethylene bottle, acid rinsed
	Zinc	μg/l	4.	2ml HNO_3/liter	0.45 μm	6 months	200.7	1 liter polyethylene bottle, acid rinsed

Quality Control Requirements

Sample bottles will be purchased commercially, will meet EPA specifications, and will be part of the quality control program. The sample containers to be used for this project will be 250 milliliter polyethylene bottles for surface water and aqueous source samples (total recoverable metals, dissolved metals, and anions)

The following types of samples will be provided for QA/QC purposes:

> Field blanks will be prepared for each group of sampling at the rate of one per 20 samples.
>
> One duplicate water matrix water sample will be collected per 20 samples shipped to determine accuracy and precision in laboratory, analytical procedures and sample collection procedures.
>
> One triple volume sample per 20 water samples can be collected, if the State's lab so requests, to provide matrix spike and matrix spike duplicate (MS/MSD) to allow for a check of laboratory quality control procedures.
>
> One de-ionized water blank will be taken from the source of DI water which will be used for all equipment decontamination rinses.

Field blanks, and duplicates will be submitted with separate sample ID's as blind samples. Any triple volume samples gathered will be designated as being for Lab QC purposes.

Instrument Calibration and Frequency

Field pH and conductivity meters will be calibrated at the beginning of each sampling day according to the manufacturers specifications. Meters will be checked periodically during the day, with particular attention being given to re-calibration when temperatures change significantly, and when the character of the water changes significantly (eg., draining adit vs. stream water.)

Inspection/Acceptance requirements for Supplies

Pre-cleaned, and pre-preserved sample bottles are obtained from ESS (Environmental Sampling Supply) or supplied by the selected laboratory. Filters for 0.45 micron filtration are ion chromatography arcodiscs obtained from Gelman sciences. Bottles and filters will be inspected before use, and any that have been damaged during shipment will be discarded to a location where they will not be inadvertently reused.

Data Acquisition Requirements

The Arrastra Creek characterization study will not be relying on any supplementary information (USGS gage data, etc). Data taken elsewhere in the Animas basin, to which this data will be compared, were collected using the protocols specified in the "Animas River Stakeholders Group Sampling and Analysis Plan, Animas River Characterization Project, San Juan County and La Plata Counties, Colorado, 1998." The protocols between that SAP and this one are similar, and should yield data that are valid for comparison.

Data Management

Field data sheets will be kept by ARSG. Lab analysis results will be transcribed into the master database (an Excel database) maintained by the Animas River Stakeholders Group, Bill Simon, Watershed Coordinator; and eventually into EPA's STORET database at discretion and task of the CDPHE.

Assessment and Response Actions

Interim reports of progress and results of the Arrastra Creek Characterization study will be given at Animas River Stakeholders Group monthly meetings. Any concerns about data collection procedures will be resolved by the Group at that time.

All field and laboratory activities may be reviewed by state and EPA quality assurance officers as requested. Results of this project will be included in a report to the Colorado Non-Point Source (319) Program.

Data Review, Validation and Verification Requirements

Interim reports of progress and results of Arrastra Creek Characterization study, including macroinvertebrate and water quality analysis, will be given at Animas River Stakeholders Group monthly meetings. Any concerns about accepting, rejecting or qualifying the data will be made by the Monitoring Working Group, Bill Simon, Chairman.

Validation and Verification Methods

Analytical results will be compared to prior data at the same locations, and also to streams in the vicinity. Outliers or nonsensical data should be obvious, given the wealth of characterization data in the Upper Animas basin. If errors are detected, transcription mistakes from field or lab sheets will be checked, and quality control analyses will be reviewed. Data entry errors will be corrected. Inconsistencies will be flagged for further review, or discarded. Any problems with data quality will be discussed by the Monitoring Working Group, Bill Simon, Chairman.

Reconciliation with data quality objectives

The objectives of this characterization study are to determine source and magnitude of metal loading in Arrastra Creek. The intent of the macroinvertebrate reconnaissance is to determine points where the water quality changes, and to focus the more expensive water quality sampling and analysis at those points. If the macroinvertebrates do not show points of change, the objectives of the study can still be met, though it will be more costly, and require more time (perhaps additional years of sampling).

Depending on the complexity of the geochemical situation encountered in Arrastra Creek, it may take several years of data collection to adequately characterize the metal sources. Other tributaries of the Animas River have undergone similar characterization of sources. One always wants more data, but the existing data sets on the other tributaries have been adequate for source analysis and recommendation of standards. The procedures described here should be adequate to generate a similar data set for Arrastra Creek.

ATTACHMENTS

Attachment 1	Animas River Field Data form
Attachment 2	Field Sample Record for CDH
Attachment 3	Chain-of-Custody form

Attachment 4	SOP for filtration
Attachment 5	SOP for flow measurement

Attachment 1 **Animas River Field Data form**
(to be included in hard copy document)

Attachment 2 **Field Sample Record for CDH**

(to be included in hard copy document)

Attachment 3 **Chain-of-custody form**
(to be included in hard copy document)

Attachment 4 SOP for filtration

from "Standard operating procedures for the filtration of water samples" from the Quality Assurance Project Plan for the Colorado Nonpoint Source Monitoring Program (attachment 4

In 1988, the Colorado Water Quality Control Commission adopted the determination of metals concentrations in surface waters be based on the dissolved fraction rather than the acid soluble or total recoverable method used previously. This was based on EPA's acute and chronic criteria which, in most cases, are equations that calculate the metals standard for **a** stream segment for aquatic life protection. (McConnell-Dissolved Metals monitoring-1988). The Aquatic Life criterion is based on the dissolved metals and the total hardness concentrations.

Dissolved metals concentrations are used to develop water quality standards, nonpoint source controls, to calculate loadings, and to develop remedial models. The methods described in this standard operating procedure document will focus on a "syringe" filter ' ing procedure, used in the field by NPS personnel in determining dissolved metals concentrations. Another common filtration procedure is the use of a Geotech filtration unit which is well documented in **McConnell's** Memo to-field samplers (Attached).

EQUIPMENT

1. 60 cc syringe w/Luer-Lok tips.
2. Swinnex disc filter holders, 47 mm diameter, polypropylene with silicone 0-rinqs.
3. Cellulose Acetate 47mm diameter, .45 um pore size filters.
4. Deionized water used for rinsing.
5. Teflon coated or nonmetal forceps.
6. Pre-acidified 250 ml bottles.
7. Precleaned and rinsed sample container. (1 liter bottle)

SITE AND SAMPLING CONSIDERATIONS

Several considerations should be taken before an actual sample is obtained.

1. Make sure the area to be sampled is thoroughly mixed with any contributing inputs such as confluences with other streams,
discharges, runoffs, mine adits, or any other water body contributor.

2. If more than one site is going to be sampled, each site should have it's own collecting and filtering equipment. This is not always practical where there are numerous sites to be monitored. In this case, 2 or more sets of equipment are used, one set at suspected contaminated sites, and one set for suspected clean sites. This technique reduces the possibility of contamination going from a highly polluted site to a relatively

clean site. If one set of collecting equipment is going to be used, sampling should progress from the clean areas to the contaminated areas. Thorough rinsing is the key to uncontaminated samples.

3. If sampling several locations on the same waterbody, a "downstream-to-upstream" approach is be used. This ensures that any substrate constituents which may be stirred up during the sampling procedure are going to flow downstream as you work upstream and will not be introduced at the next station.

SAMPLE PREPARATION

All sampling equipment must be cleaned and rinsed before any sample collection may take place. The Colorado Department of Health Laboratory supplies all sampling containers and preacidified 250ml metals containers which are cleaned under the laboratory's Quality Assurance Plan.

The filter holders and syringes must also be clean. Disassemble the filter holder apparatus. The 0-rings on the upper and lower section of the holders are soaked in deionized water for 24 hours. The filter holders and syringes must be soaked in a 5% nitric acid, 95% deionized water mixture for 24 hours. Then rinsed with deionized water prior to use.

QUALITY ASSURANCE

A duplicate sample will be collected at 10% of the sampling stations for QA purposes. The duplicate is taken out of the same contain ' er as the stream sample. Rinsing of the filter holder and a new filter are placed in the filter holder using the procedures described. The duplicate sample will be labeled "FILT DUP", along with the site name or number, date, time, and name.

A "BLANK" sample of the de-ionized water used in rinsing is taken at the end of each sampling day. The same rinsing and filtering procedure is used for the sample.

FILTRATION PROCEDURES

1. Rinse a 1-liter neutral (unpreserved) container with the water to be sampled at least three times before gathering a sample to be filtered on-site or in a lab (camper-lab). Fill container and cap for later filtering. Filtering is done no later than a half an hour after collection.

2. Locate a dust free environment as possible, ideally, a mobile or camper lab to set up and filter.

3. Rinse the syringe and filter holder with de-ionized water.

4. Place a clean filter in the filter holding apparatus using non metal (clean and rinsed) forceps.

5. Run 50 ml of de-ionized water through the filtering apparatus using the syringe. Do not collect this.

6. Run 50 ml of sample water through the filtering apparatus using the syringe, again, do not collect this.

7. After being completely rinsed and flushed, the sample may be filtered into the pre-acidified container. Do not rinse the pre-acidified container. If the filter begins to clog, do not force the sample through the filter, but replace with a new filter after following the rinsing procedures.

8. Fill the sample container to the rim of the pre-acidified bottle. The container has a predetermined amount **of** preservative for a full sample.

9. Label bottle with the site, time, date and sample type, i.e. "Filtered",, "Filt Dup", or "Filt Blank".

10. Immediately and thoroughly rinse all filtering equipment with de-ionized water before it dries and place in a zip lock storage bag for transport to the next site.

11. Upon completion of a sampling run, the filtering apparatus should be taken apart and soaked in a mixture of 5% nitric acid and 95% de-ionized water for 24 hours as described above.

Attachment 5 Flow Measurement

(from "Standard operating procedures for the collection of flow, pH, temperature and conductivity measurements" from the Quality Assurance Project Plan for the Colorado Non-point Source Monitoring Program)

FLOW MEASUREMENTS:

OVERVIEW:

Discharge measurements are a vital part of water quality sampling. Discharge is used in constituent loading formulas, dilution factors, and discharge rates, as well as other aspects in which the rate of flow in needed. This Standard Operating Procedure will focus predominantly on instantaneous flow measurement procedures for open channels as needed in water quality sampling protocols.

TYPES OF FLOWMETERS

There are different types of flowmeters available for use, such as the Pygmy, Marsh-McBirney, and Price AA meters. Although they operate differently, they provide comparable results. Follow the individual unit's manufacturer's instructions.

CALIBRATION SCHEDULE

sampling personnel should calibrate their flowmeters at least once per year. The USGS or the local supplier of flowmeters should have a flume setup in which flowmeters may compare readings to the known flow of the flume, traceable to the National Bureau of Standards.

QUALITY ASSURANCE USING DIFFERENT FLOWMETERS IN A STUDY

In detailed and intense studies, in which many crews are involved, a quality assurance check should be done at the beginning of each sampling day to ensure that proper and comparable flow readings are being taken. This involves eliminating as many different factors as possible. Use of the same type of meter is ideal but not always the case. Steps to be taken include:

1. Taking flow measurements at an identical location.

2. Using the same cross section intervals.

3. Each crew shall use the same technique they are going to use in the field to collect their flow measurements.

4. Field notes and field forms should be the same or similar for use in the same study. (See attached discharge measurement form)

5. Final flow measurements should compare to within 10% of each other. Make any necessary adjustments and duplicate flow procedures until within 10%. (See discharge calculation section). Follow flowmeter's manufacturer's instruction manual. Marsh McBirney instruction manual attached.

SELECTION OF STREAM SITE FOR FLOW READING

Selecting a cross section of a stream or channel for flow measurement requires careful consideration.

1. Select a stretch in which the stream is not turbulent, or fluctuating from side to side. Preferably a glide type area.

2. Suspend a measuring tape, which is calibrated in feet and foot-tenths, one foot above the stream or channel, perpendicular to the flow.

3. Measurements will be made perpendicular to the flow, facing upstream. Measurements will be in feet/second.

4. If depth is less than 2.5 feet, the flow measurement will be taken at 60% of the depth, from the surface. This is the standard setting of the top setting rod. If over 2.5 feet in depth, a two point method is used, which is the average velocity at a 20% and 80% depth measurement. This is done by calculating the 20 and 80% depths and placing the electromagnetic sensor (Marsh-McBirney Model) on the top setting rod, at the distance from the surface.

5. Try to avoid areas where there are dead pools of water such as behind large boulders.

6. Take a minimum of 10 measurements within the stream channel, including distance from bank, depth, and velocity. The more segments you use the better the result. Also record the bank distances. (See flow data sheet attached). If the difference in velocity between two adjacent segments is greater than 10%, the segments should be smaller.

7. Follow the manufacturer's instructions for individual types of flowmeters.

DISCHARGE CALCULATION

Stream Profile:

W4 W5 wx

(in the hard copy document, stream cross section goes here)

45 Dx

where;

W = Measured width of segment
V
A = Calculated area of segment
D = Measured depth of segment
Q = Calculated flow of segment

= Measured velocity of segment

Calculate the,area of each segment by: **(Dx** + D-') / 2 * (Wx + Wx-') / 2 = A' Calculate

the average velocity of the segment:

$$V\text{-}9 = (Vx + Vx\text{-}') / 2$$

'Then calculate the flow of each secjment by:

$$Ax * vx = Q\ x$$

Sum the flow of the segments for the total flow.

$$Ql + Q2 + Ql + . . + \mathbf{Qx = Qtt}$$